National Aeronautics and Space Administration

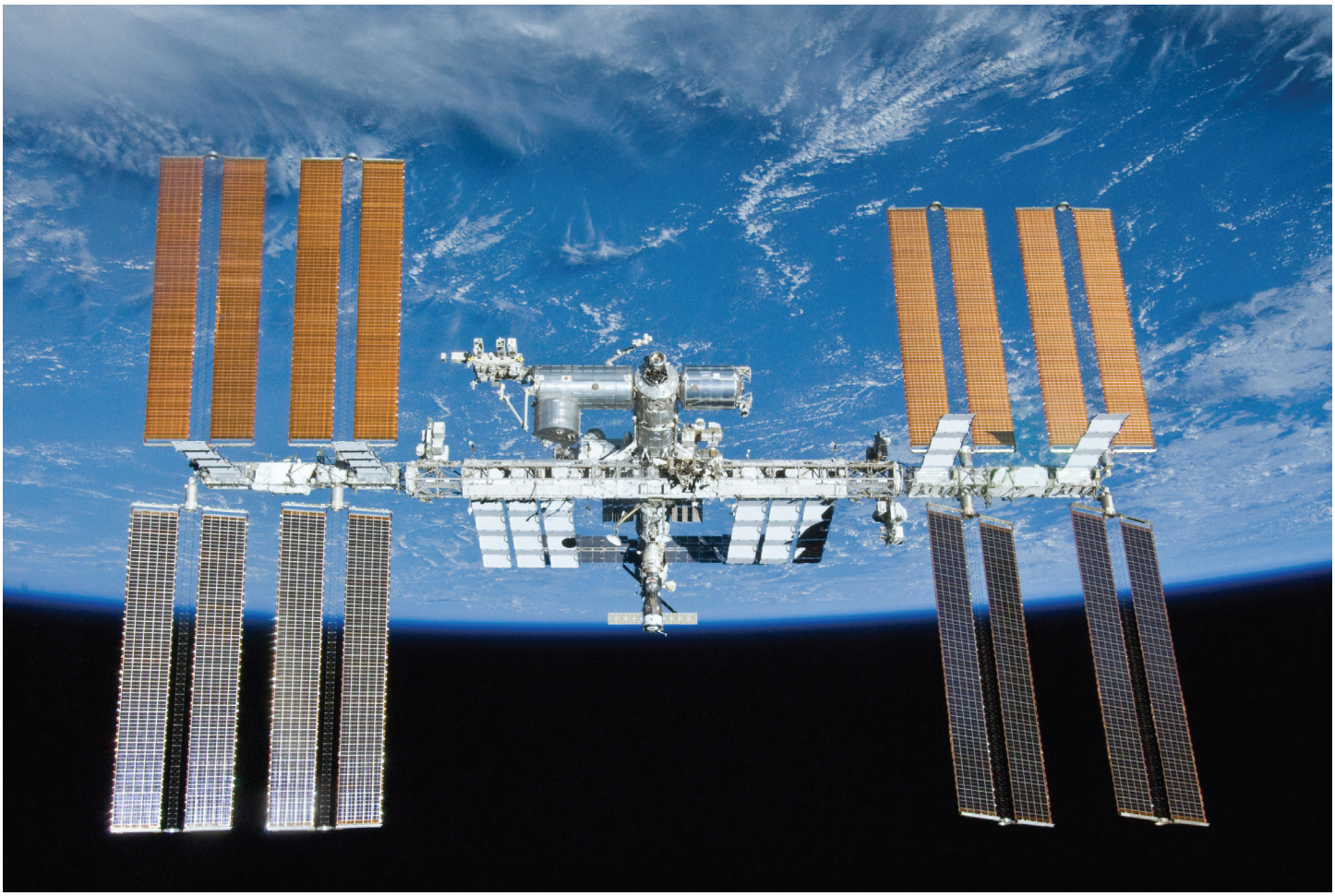
Payload Systems

Proven Processes Reduce Cost and Time

Marshall Space Flight Center has proven processes to design, develop, test, and integrate payloads for on-orbit operations. Programs such as Shuttle and International Space Station (ISS) have very stringent verification requirements, and Marshall has matured its capability to meet these requirements consistently. As a result, sole verification responsibilities have routinely been delegated to the Center. Because of the Center's engineering and systems integration expertise and understanding of customer requirements and environmental conditions, Marshall's validation, verification, and flight certification processes are well regarded. Because Marshall's processes have been optimized internally, verification and validation tests are performed efficiently, resulting in schedule savings. Flight opportunities are limited and often scheduled years in advance. Missing a window for the next launch vehicle can be costly, but because Marshall payloads do not require additional testing at the program level, there are additional schedule savings.

At-A-Glance

Marshall has a rich heritage in the development and testing of payloads, racks, systems, and components. The Center's reliable and demonstrated processes result in efficient payload delivery and successful teaming with international partners, academia, other NASA centers, and industry. Marshall's expertise and unique facilities serve as a conduit for reliable and effective advancement of payload development and demonstration.



Unique human spaceflight safety requirements have led to implementation of rigorous Marshall safety processes and requirements. Each project has a safety engineer matrixed to the team. Payloads are taken through a process of very robust requirements. Marshall develops and integrates safety data packages, which are presented for review and approval by multilevel boards following a governance process.

Marshall also performs end-to-end tests allowing earlier identification of problems and time for the payload team to correct issues before on-orbit operations. Crew time is extremely expensive and limited, so effective ground-based troubleshooting is critical.

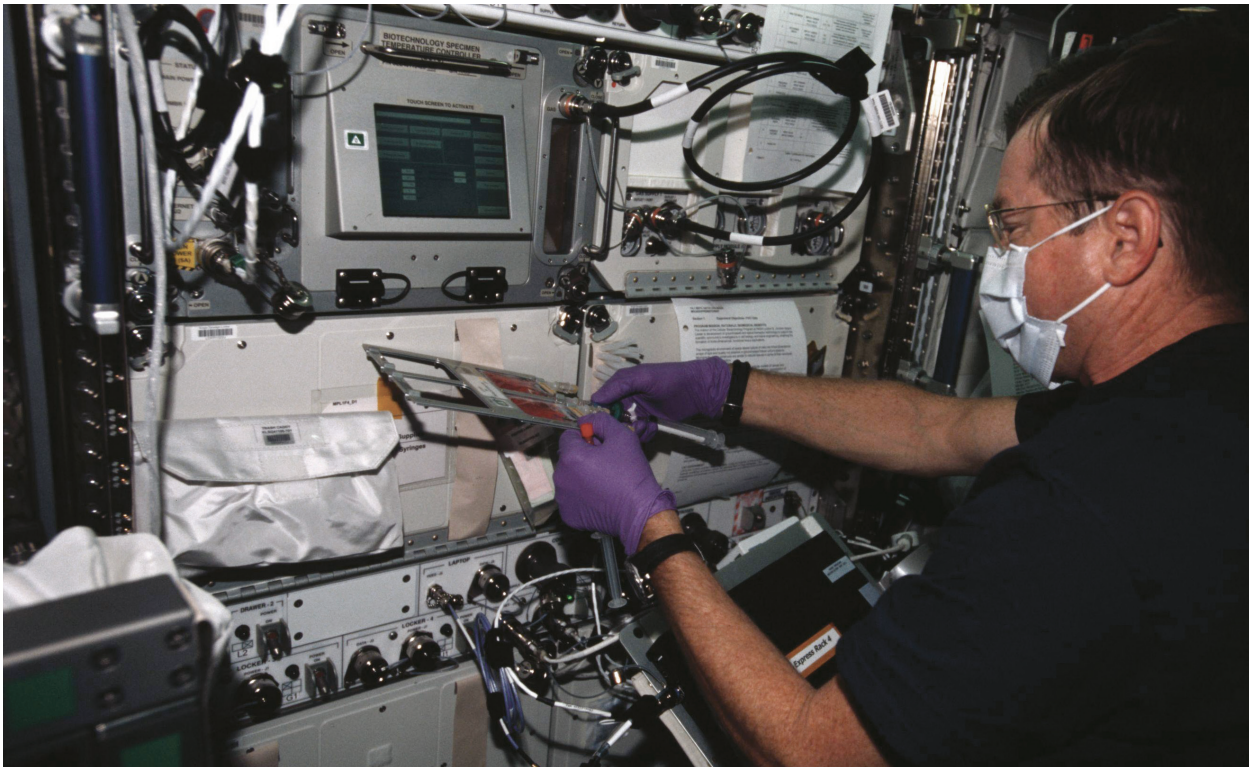
Expertise with On-Orbit Research Facilities

Marshall has a deep heritage in engineering and payload management that dates back to Skylab and Spacelab. The Center designs, develops, manufactures, tests, operates, manages projects, and interfaces with the customer organization. Because of Marshall's role in developing and operating these facilities, the Center offers unique insight and expertise to payload developers who need to integrate with them on-orbit.

Marshall's test suite is connected to the Huntsville Operations Support Center (HOSC) for full software verification and validation checkout. Marshall is the only center that provides this unique capability to the Agency, enabling true end-to-end testing of payload telemetry.

Marshall's expertise is demonstrated and enriched by its ISS research facilities, such as the EXPRESS suite of racks, Microgravity Science Glovebox, and the Material Science Research Rack-1. The Center's development and operation of these facilities allows insight and expert integration of systems and processes required to deliver on-orbit payloads. The EXpedite the PRocessing of Experiments to the Space Station (EXPRESS) Rack is a standardized payload rack system that transports, stores, and supports experiments aboard the ISS. It was developed specifically to maximize the station's research capabilities by providing small payloads with a shortened integration time. With its standardized hardware interfaces and streamlined approach, the EXPRESS Rack enables quick, simple integration of multiple payloads aboard the ISS, resulting in easier and more affordable delivery of payloads.

The Microgravity Science Glovebox (MSG) enables scientists from multiple disciplines to participate actively in the assembly and operation of experiments in space with much the same degree of involvement they have in their own research laboratories. Developed by the European Space Agency (ESA) and managed by Marshall, the MSG was launched to the ISS in June 2002. This facility offers an enclosed 255-liter (9-cubic-foot) work area accessible to the crew through glove ports and to ground-based scientists through real-time data links and video. Because the work area is sealed and held at a negative pressure, the crew can manipulate experiment hardware and samples without the danger of small parts, particulates, fluids, or gasses escaping into the open laboratory module.



EXPRESS allows rapid integration of multiple payloads, streamlining payload operations.

The Material Science Research Rack-1 (MSRR-1) is an International Standard Payload Rack outfitted with custom-designed subsystems to provide ground controllers or the onboard crew with the capability to monitor and control high-temperature material research. Marshall designed and developed the subsystems to accommodate the operations of the MSRR. Marshall also performed the hardware/software integration, testing, and verification necessary to certify the facility for flight.

Stand-Out Facilities

The Space Systems Integration and Test Facility is a unique multipurpose facility that enables the design and development of space systems from proof-of-concept studies, prototype and development hardware check-out, integration and assembly of flight systems, and qualification and acceptance testing of components, subsystems, and integrated systems through real-time operations of on-orbit payloads. To implement these functions, the facility incorporates a 10,000-square-foot temperature- and humidity-controlled high-bay work area. The high bay is fully equipped for handling flight hardware.

A Payload Rack Checkout Unit (PRCU) is used for verification and validation of ISS-class payloads and sub-rack payloads. The PRCU, located in the Space Systems Integration & Test Facility, provides a high-fidelity emulation of ISS resources including command and data handling, power, cooling, video, vacuum, and gas distribution.

Marshall's custom-designed MSRR subsystems enable users to conduct high-temperature materials experiments on ISS.

3-D Payload Will Reduce Future Payload Costs

Marshall has joined with Made in Space, a Moffett Field, California, company, to develop and test a 3-D printer that will build tools on the ISS. The 3-D Printing in Zero-G Technology Demonstration payload will perform the first-ever 3-D printing on the space station platform to begin changing the current model for resupply and repair to one that is more suitable for all exploration missions.

Marshall's role is to guide the design process and conduct all of the reviews for the experiment, including project design and critical design, and the environmental and qualification testing to ensure that the hardware is flight certified. Testing is being conducted at various Marshall facilities.

The 3-D Print technology demonstration payload will use extrusion additive manufacturing that builds objects, layer-by-layer, out of polymers and other materials. The first practical applications for the printer payload include certain kinds of widgets, everyday parts like spacers for drawers or shelves. The print-on-demand capability removes any logistical considerations, such as planning for storage or accounting for the mass in payload calculations.

The 3-D printing payload could also spare astronauts from having to wait for replacement parts. At $10,000 per pound, shuttling cargo into space is extremely expensive and slow, with six months or more before new supplies can be brought to the station. It will allow crew members to make some objects in less than an hour. This will speed up development time, accelerate the innovation cycle, and increase the safety of space missions. By increasing reliability on what the crew can build themselves, NASA will also decrease its reliance on commercial payload launch schedules, saving a considerable amount of money.

Marshall supported Made In Space in certifying their 3-D printer for installation on the ISS.

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